REMARKS

Favorable reconsideration of this application in light of the following discussion is respectfully requested.

Claims 1-31 are presently active in this case; Claims 7-9 having been amended by way of the present amendment. The above amendment shows the amended claims in clean form, the attachment shows a marked-up copy of the amended claims for the Examiner's convenience.

In the outstanding Office Action, the election of species requirement was made final. Claims 7-8 were objected because of an informality. Claims 1-4, 7, 8, 10, 11, 17, 18, 20 and 21 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Tsuji et al (U.S. Patent No. 5,471,068) in view of Takagi et al (Design of multi-quantum barrier ...). Claims 13-16 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Tsuji et al / Takagi et al in view of Motoda (U.S. Patent No. 5,737,350).

In response to the objection to Claims 7-8, these claims are amended to correct the informality.

In response to the rejections of Claims 1-4, 7, 8, 10, 11, 13-18, 20 and 21 under 35 U.S.C. § 103(a), Applicant respectfully requests reconsideration of these rejections and traverses the rejections as discussed next.

Briefly recapitulating, Applicant's invention relates to a light-receiving device that includes a quantum-wave interference layer having a plurality of periods of a pair of a first and second layers. The thicknesses of the claimed layers is an even multiple of $\lambda/4$, where λ is the quantum-wave wavelength of carriers in each of the first and second layers. Applicant's invention provides an increase in the conduction (or transmission) of the carriers

through the quantum-wave interference unit.[1] Advantageously, the thickness of the layers in the quantum-wave interference unit can be adjusted so as to increase the unit's transmission selectively either for electrons or for holes, depending on which carriers are desired to be transmitted through the unit.[2]

The present invention has a different structure and a different principle for transmitting electrons/holes from those disclosed in the prior art. Although in the prior art a virtual barrier is calculated to have a height twice as high as that of an actual barrier, it is not actually confirmed by carrying out any experiment and the calculation of the thickness is unclear.

More to the point, in the present invention, as illustrated in the attachments to this Amendment, after determining one value of the kinetic energy E_0, the thicknesses D_W and D_B are determined by $\lambda/2$ as shown by the equations (1) and (2). With respect to the determined thicknesses D_W and D_B, the kinetic energies E_1 and E_2 of the first layer and the second layer, respectively, cannot be the same value for one time, three times, four times, ..., and n times multiplying $\lambda/4$, or $3\lambda/4$, λ, and $n\lambda/4$. (Equation (8)). Consequently, because V is added to equation (2) in equation (1), a E_0 that satisfies equations (1) and (2) does not exist. The point is that E, which satisfies the equations (1) and (2) with respect to the determined thicknesses D_W and D_B, is nothing but E_0.

The outstanding Office Action seems to consider that an energy which satisfies $n\lambda/4$ exists infinitely. Applicant disagrees with this position. As illustrated in the attachments, when $\lambda/2$ matches with the energy E_0, the first layer and the second layer ***do not satisfy*** the condition $n\lambda/4$ in common even by increasing the energy E_0. Accordingly, the present

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[1]See Applicant's specification for example, from page 7, line 15 to page 8, line 26.

[2]See Applicant's specification for example, from page 8, line 26 to page 9, line 19.

invention only transmits electrons in a certain energy E_0. Finally, the present invention uses the energy E_0 of the highest electric concentration in a conduction band in order to determine thicknesses D_W and D_B. Accordingly, the present invention is quite different from the devices disclosed in the cited prior art, which neither teaches nor suggests the claimed invention.

Consequently, in view of the present Amendment, no further issues are believed to be outstanding in the present application, and the present application is believed to be in condition for formal Allowance. A Notice of Allowance for Claims 1-31 is earnestly solicited.

Should the Examiner deem that any further action is necessary to place this application in even better form for allowance, he is encouraged to contact Applicant's undersigned representative at the below listed telephone number.

Respectfully submitted,

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IN THE CLAIMS

Please amend Claim 7-9 as shown below:

--7. (Amended) A light-receiving device according to claim 1, wherein said carrier accumulation layer has the same [bandwidth] bandgap as that of said first layer.

8. (Amended) A light-receiving device according to claim 3, wherein said carrier accumulation layer has the same [bandwidth] bandgap as that of said first layer.

9. (Amended) A light-receiving device according to claim 5, wherein said carrier accumulation layer has the same [bandwidth] bandgap as that of said first layer.--

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D_W and D_B are decided by E_0

$$\frac{\lambda_W}{2} = D_W = \frac{h}{2\sqrt{2m_W(E_0+V)}} \quad \cdots (1)$$

$$\frac{\lambda_B}{2} = D_B = \frac{h}{2\sqrt{2m_B E_0}} \quad \cdots (2)$$

E_1 which is corresponding to $\frac{n\lambda_B}{4}$ is obtained as follows.

$$\frac{n\lambda_B}{4} = \frac{nD_B}{2} = \frac{h}{2\sqrt{2m_B E_1}} \quad \cdots (2-1)$$

Here n is integer $\geqq 1$.

from Eq. (2−1).

$$E_1 = \frac{h^2}{2m_B D_B^2 n^2} \quad \cdots (3)$$

E_2 which is corresponding to $\frac{n\lambda_W}{4}$ is obtained as follows.

$$\frac{n\lambda_W}{4} = \frac{nD_W}{2} = \frac{h}{2\sqrt{2m_W(E_2+V)}} \quad \cdots (1-1)$$

from Eq. (1−1).

$$E_2 = \frac{h^2}{2m_W D_W^2 n^2} - V \quad \cdots (4)$$

We get Eq. (5) eliminating E_0 from Eqs. (1) and (2).

$$V = \frac{h^2}{8}\left(\frac{1}{m_W D_W^2} - \frac{1}{m_B D_B^2}\right) \quad \cdots (5)$$

Accordingly Eq. (6) is obtained from Eqs. (4), (3), (5).

$$E_2 - E_1 = \frac{h^2(4-n^2)}{8n^2}\left(\frac{1}{m_W D_W^2} - \frac{1}{m_B D_B^2}\right) \quad \cdots (6)$$

Substituting $\left(\frac{1}{m_W D_W^2} - \frac{1}{m_B D_B^2}\right)$ of Eq. 5 into Eq. (6), we get Eq. (7)

$$E_2 - E_1 = \frac{(4-n^2)V}{n^2} \quad \cdots (7)$$

As a result,

When $n=2$, $E_2 = E_1$.

When $n \neq 2$, $E_2 \neq E_1$. $\cdots (8)$

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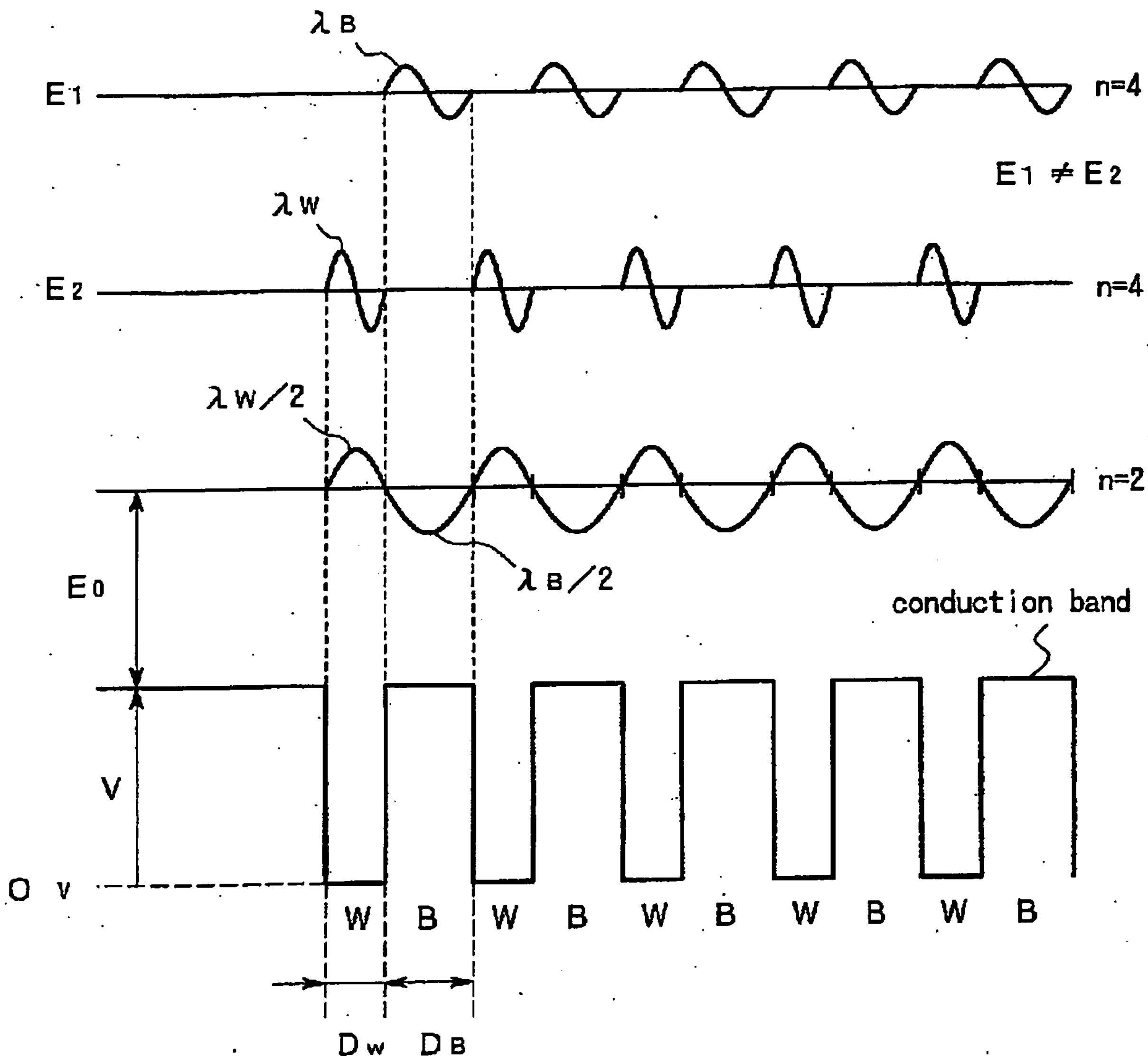
ATTACHMENT 2



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